Energy, Mines and Resources Canada
Énergie, Mines et Ressources Canada

Canada

VILLAGE ENERGY RETROFIT
OF ELECTRIC DOMESTIC WATER HEATING
IN A B.C. HYDRO DIESEL GENERATION AREA

VILLAGE ENERGY RETROFIT OF ELECTRIC DOMESTIC WATER HEATING IN A B.C. HYDRO DIESEL GENERATION AREA

PREPARED BY BC HYDRO
WITH A CONTRIBUTION FROM
THE REMOTE COMMUNITY DEMONSTRATION PROGRAM

SEPTEMBER 1988

Distribution of this report by Energy, Mines and Resources Canada does not necessarily signify that the contents reflect the views and policies of EMR. Mention of trade names and commercial products does not constitute recommendation or endorsement for use.

© Minister of Supply and Services Canada 1989

Catalogue No. M91-7/42-1989E
ISBN 0-662-16731-7

TABLE OF CONTENTS

	Page
EXECUTIVE SUMMARY	i
INTRODUCTION	1
OBJECTIVES	1
BACKGROUND	1
TENDERING & PURCHASING	2
ADVERTISING & PROMOTION	3
METER READER CONTACT	3
CONTRACTOR TRAINING WORKSHOP	4
DISTRICT ACTIONS	5
CONTRACTOR ACTION	5
PUBLIC RESPONSE	6
NEW HOME UPGRADE	6
LARGE BUILDING RETROFIT DEMONSTRATION	8
MONITORING & RESULTS	9
DISCUSSION OF RESULTS	10
RESULTS OF OTHER STUDIES	11
SUMMARY	11
REFERENCES	12

APPENDICES

A. MAP INDICATING B. C. HYDRO DIESEL GENERATION AREAS

B. APPLICATION FORM

C. CONTRACTOR TRAINING WORKSHOP AGENDA

D. INSTALLATION RECORD FORM

E. RECOMMENDED INSULATION LEVELS

EXECUTIVE SUMMARY

In early 1987, B.C. Hydro, with financial assistance from Energy, Mines and Resources Canada, supplied and installed over 2000 insulating blankets on electric water heaters, in B.C. Hydro's diesel generation areas. Shower restrictors and tank thermostat turndowns were also offered.

Monitoring of electrical consumption of the serviced homes indicates reduction of approximately 950 kW.h/yr due to the blanket.

One new home was upgraded to energy efficient standards and proved that the necessary skills and materials are readily available in remote communities.

An electrically heated office building was retrofitted with air source heat pumps, and a number of simple energy saving devices and modifications to reduce electricity consumption were incorporated into the building. In the October 1987 through May 1988 heating season, although there were 3% more heating degree days there was a 25% reduction in both energy consumption and peak demand, when compared to the same period in 1986-87.

In spite of declining diesel fuel prices, and therefore reduced losses since this program was undertaken, payback to B.C. Hydro is estimated to be 1.5 years. Without EMR's contribution, payback would be 3 years.

As a result of the experience gained and results obtained from this project, B.C. Hydro extended the domestic water heater energy conservation program to its hydro-electric grid area as part of an extensive demand side management program. Seven communities or districts were served in the summer of 1988, with the balance to be done over 3 to 5 years.

RÉSUMÉ

Au début de 1987, avec l'aide financière d'Énergie, Mines et Ressources Canada, B.C. Hydro a fourni et installé plus de 2 000 garnitures calorifuges sur des chauffe-eau électriques, dans des zones où l'électricité est fournie par des générateurs fonctionnant à l'huile diesel. En même temps, on a proposé de munir les douches d'un réducteur de débit et le thermostat des chauffe-eau d'un dispositif de réglage.

La courbe de la consommation électrique des maisons alimentées en électricité par B.C. Hydro montre une réduction d'environ 950 kWh/année grâce à la garniture.

Les modifications qui viennent d'être faites sur une maison neuve vient de faire l'objet en application des "normes de réduction de consommation d'énergie" montrent que les matériaux et le personnel nécessaires pour réaliser une telle intervention sont faciles à trouver, même dans une localité éloignée.

On a équipé un immeuble de bureaux initialement chauffé à l'électricité de thermopompes utilisant l'air comme source de chaleur; en même temps, on a réduit sa consommation d'électricité en y faisant un certain nombre de modifications élémentaires et en y installant des dispositifs simples d'économie d'énergie. D'octobre 1987 à mai 1988, c'est-à-dire pendant la période de chauffage, on a constaté une réduction de 25 % par rapport à la même période de 1986 à 1987, à la fois dans la consommation d'énergie et dans le niveau de la demande en période de pointe, alors que cette période comptait 3 % de degrés-jours inférieurs de plus que celle de l'année précédente.

En dépit de la baisse du prix du carburant diesel, donc de la diminution des pertes depuis la mise en place du programme, on estime que B.C. Hydro pourra amortir ses frais en 1,5 an. Sans la contribution d'EMR, il lui faudrait 3 ans.

L'expérience acquise et les résultats obtenus à la suite de ce projet ont incité B.C. Hydro à étendre à sa zone quadrillée hydro-électrique son programme d'économie d'énergie appliqué aux chauffe-eau domestiques dans le cadre d'un vaste programme de gestion axé sur la demande. Le programme a été appliqué dans sept collectivités ou districts pendant l'été 1988; il faudra 3 à 5 ans pour qu'il le soit dans tous les autres.

DIESEL AREA CONSERVATION PROJECT

INTRODUCTION

In the fall of 1986, B. C. Hydro & Power Authority (B. C. Hydro) & Energy Mines & Resources Canada (EMR) entered into an agreement under EMR's Remote Community Demonstration Program (RCDP), to share the cost of an electricity conservation program in several communities where B. C. Hydro generates electricity using diesel engines. B. C. Hydro supplied and installed domestic hot water insulation blankets, shower restrictors and adjusted tank thermostats in over 2000 homes. A financial incentive was offered to upgrade three new homes to B. C. Hydro energy efficiency recommendations and an existing commercial/institutional building was identified and a financial incentive provided to upgrade the energy efficiency of the building.

OBJECTIVES

B. C. Hydro has an ongoing objective of reducing the consumption of electricity in diesel areas in order to reduce fuel consumption and the associated financial losses.

EMR, through its Conservation & Renewable Energy Office (CREO) wishes to encourage alternative-to-oil and energy conservation technologies in remote communities. A reduction in electrical consumption which results directly in a reduction in consumption of diesel fuel is therefore within EMR's objective.

BACKGROUND

B. C. Hydro generates electricity primarily by water power and transmits electricity via a grid system which reaches all but a few relatively remote communities in the province. In these remote communities, power is generated by diesel engines and the rate structure is such that revenue does not cover the cost of fuel. Further losses are incurred in the operation and maintenance of the engines and distribution systems.

In 1984/85, B. C. Hydro conducted a pilot conservation project in two diesel areas - Anahim Lake and Tatla Lake (see map, Appendix A). B. C. Hydro supplied and installed insulation jackets on residential domestic hot water heaters, adjusted the tank thermostat settings, installed shower restrictors and supplied a power-saver cord for vehicle plug-ins.

The electrical consumption of houses so treated was compared over a six month period (1 November 1984 to 30 April 1985) with a control group of untreated houses. The results of this monitoring indicated a reduction in electrical consumption of 1956 kW.h per year per household fitted.

This was subsequently revised to a reduction of 715 kW.h/yr for the first three energy savers (i.e. no power-saver cord).

Average production in B. C. Hydro's diesel stations is 3.1 kW.h/L of fuel. At fuel costs then prevailing, it was costing B. C. Hydro 10¢ worth of fuel to produce one kW.h of electricity which it sold at approximately 4¢. (By June 1988, losses had declined to approx. 4.3¢/kW.h due to lower diesel fuel costs.)

A 715 kW.h/yr reduction in consumption saves the customer about $28/yr, saves B. C. Hydro approximately $43/yr and offsets the use of 230 L of diesel fuel annually.

It was projected that if a similar program was offered in other diesel areas, 2200 additional homes (approximately 50% of the residential accounts) could be equipped with these conservation measures, resulting in a saving to B. C. Hydro of over 438,000 litres of oil per year and a net reduction of losses of over $81,000/yr.

A detailed budget was prepared early in 1986, and B. C. Hydro submitted a formal proposal to EMR soliciting EMR participation in such a conservation program, on a cost-sharing basis under EMR's Remote Community Demonstration Project. During preliminary discussions EMR had proposed expansion of the project to include:

- upgrading three new homes to insulation levels above those presently used as standard practice;
- the retrofit of an existing electrically heated public/ commercial/institutional building for energy efficiency;
- public seminars on energy conservation;
- slide presentation and script on the project, to be useful in other diesel areas in Canada as a demonstration of practical technology.

A contract was signed in November 1986 and the project proceeded to the tendering and purchasing stage.

TENDERING & PURCHASING

Five manufacturers were invited to bid on the supply of the insulating blankets. Blankets were required to comply with CGSB Specification 51-65M (1986), complete with securing belts or straps.

The low bidder was the same company that provided the blankets for the pilot project at Anahim Lake. Their product was in accordance with the specifications and they were awarded the contract.

Tenders were also called in the diesel areas for four contractors to install the blankets and shower restrictors, adjust the hot water tank thermostats and act as energy conservation advisors in their respective areas. Bids were invited for the following areas:

- Atlin
- Stewart, Iskut, Dease Lake and Telegraph Creek
- the Queen Charlotte Islands
- Bella Bella, Bella Coola.

Contracts were awarded to the low bidder (in all but one area, only one bid was received).

ADVERTISING & PROMOTION

B. C. Hydro advertised the offer of the free insulating jacket in the newspapers (mostly weeklies) in the communities involved and simultaneously issued a press release containing more details on the program. The idea was that Hydro would pay for the advertising while the papers would print the press release as a public interest story. This happened as planned, although the effect of the advertising was not directly measurable. However, it did allow B. C. Hydro to publicly announce a deadline to the offer.

The advertising department also prepared posters and counter cards for the district offices in the diesel areas. District managers were instructed to get the posters placed in high-profile locations, e.g. stores, pubs, community centres, etc. The counter cards were to be given to people who entered the office to conduct business with B. C. Hydro. They were actually an application form for the service offered (Appendix B).

METER READER CONTACT

B. C. Hydro meter readers use an electronic recording device called a "Porta-processor" to record meter readings. These have the facility to be programmed to record some information other than meter readings. Arrangements were made to have the meter readers make personal calls on each household as they made their rounds and ask the occupants if they would like to take advantage of the program. Their answers were recorded on the Porta-processor.

Unfortunately, due to an administrative error, this information was lost when it was transferred to Head Office. However, it is felt that the concept was sound and is a good way of "selling" participation in any utility program.

The advertising, counter-card registration forms and meter reader contacts did not result in the number of applications anticipated. Other methods were needed to make the program a success, and these are discussed later in this report.

CONTRACTOR TRAINING WORKSHOP

It was evident from the outset that a training session for the contractors was necessary so they would know how to safely adjust tank thermostats, check for electrical hazards and deficiencies, how to install the blankets to CGSB specifications, and how to be "energy advisors" in their areas.

Highlights of the two-day course were:

- instructions by an inspector from the provincial Electrical Safety Branch on wiring identification, tank thermostat adjustment, and detection of electrical faults and hazards;
- discussion of administrative procedures and alternatives;
- weatherization of housing.

The full agenda for the meeting is contained in Appendix C.

Each contractor was provided with a small electrical test meter (volts, amps, ohms). A hot water tank, borrowed from a local plumbing wholesaler, was used for the demonstration of safety checks, thermostat adjustment and blanket installation.

The electrical inspector provided all the instructions on identifying approved and non-approved wiring, using the testing meters and identifying potentially hazardous situations. His services were extremely valuable.

An installation record form (Appendix D) had been prepared to act as a basis for payments to the contractor, to provide data for monitoring and to acquire data on housing stock, family size and the number of electric space heating accounts in diesel areas.

It was decided that meter numbers would be accepted in lieu of the customer's account number, since meter numbers are easier to obtain and B. C. Hydro's computerized record system can relate one to the other.

Three of the four contractors hired, and two of the three district managers involved attended the seminar. The missing contractor, from the very remote community of Atlin, was an electrician by trade and it was felt that he could receive adequate instructions by phone and mail. The manager of the Stewart District was absent due to business pressures.

The Stewart district turned out to be the only area with any problems and had the lowest and slowest installation rate. While the problems cannot be directly attributed to the district manager's absence from the training workshop, his attendance would have been beneficial to the project.

The training workshop provided an opportunity for the project management team, district managers and the contractors to get to know each other and for the management team to assess the capabilities of the contractors.

DISTRICT ACTIONS

B. C. Hydro's district offices were assigned the following function:

- collect names of applicants for the services offered;
- store materials for the contractors;
- check contractors work as required and handle complaints, if any, from customers;
- check and approve payment of invoices for installations, travel, trucking and out-of-town expenses;
- order literature for the contractors to distribute in their roles as energy advisors;
- provide feedback to the management team re: material quality, public response, etc.;
- take photographs of installation work for use in a documentary slide presentation;
- locate a new house in the planning or early construction stages and induce the owner to consider making it more energy efficient.

In all districts, pre-registrations for the free service were well below numbers anticipated.

In Bella Coola, the district manager employed a part-time clerk to phone all the residential customers in the Bella Coola Valley and offer them the service. This was so successful that demand exceeded supply and extra blankets were requested.

CONTRACTOR ACTION

Once the contractors began their installation work they passed on suggested installation improvements, most notably the need for tape, despite the fact that the blankets are held in place by belts. Although tape had not been considered in the budget, the project management team had faith in the field personnel and agreed to provide it.

A white vinyl tape to match the tank jacket was considered to be too expensive and an inexpensive white packaging tape was supplied. Feedback was prompt and negative. The district manager in Bella Coola purchased duct tape locally, the contractors approved of its qualities and recommended that duct tape be provided. Although the dark grey duct tape is not the most desirable from an appearance point of view, it has the essential quality of adhering well to the vinyl facing of the insulating blanket and the enamelled steel jacket on the hot water tank.

On the Queen Charlotte Islands, public response to initial requests for applications were disappointing. The contractor conducted a door-to-door "sales" campaign. Once begun, this approach, plus word-of-mouth information transfer amongst householders resulted in the targetted number of installations.

The contractor in Stewart discovered that he was allergic to fiberglass and resigned after installing about twelve blankets. His resignation necessitated finding another contractor to complete the project. No contractor was willing to do all four communities involved (Stewart, Iskut, Dease Lake and Telegraph Creek). An electrical contractor in Dease Lake was approached and agreed to undertake the Dease Lake, Iskut and Telegraph Creek installations. Another contractor in Stewart agreed to service Stewart only. Although both contracts were at prices higher than the original bid, Hydro had little choice but to proceed as quickly as possible. To date the number of installations in the Stewart district has been disappointing.

PUBLIC RESPONSE

Public response to the initial advertising and promotion was poor despite the fact that the blanket installation and other services were absolutely free. It took personal contacts to give away the allotted number of installations; in Bella Coola, telephone soliciting worked; in the Queen Charlottes, door-to-door calling by the contractor was successful. In the Stewart area, additional measures were not taken, consequently there were blankets left over. The advertising did serve to make the public aware of the program and made it easier to approach them personally.

Once contacted personally, public response was favorable, even enthusiastic. It is felt that this program has been one of the best public relations exercises ever undertaken by B. C. Hydro.

There were only a few complaints after the blankets were installed. Some people found the new thermostat setting too low - these were adjusted back up to satisfy the customer. There were several cases of the contractor forgetting to turn the breaker back on after completing his work, although they were an insignificant number as a percentage of the total number of blankets installed.

NEW HOME UPGRADE DEMONSTRATION

EMR offered to provide a total of $9000 towards the cost of upgrading three new homes in the diesel districts from presently accepted insulation practices to energy efficient standards.

Present practices in coastal regions of B. C. generally include 38 x 89 mm (2 x 4) studs and RSI 2.1 (R 12) insulation in the walls, RSI 4.9 (R 28) in the attic and double glazed windows with 12 mm (½") air space. Concrete basements, when used, are seldom insulated. The edges of slab-on-grade floors are also not insulated, as a rule.

The objective of this phase of the project was to utilize local owners and builders to demonstrate some energy efficient building concepts to local residents. In return for the incentive financing of $3000 per home, the builder(s) would be required to upgrade wall, ceiling and basement insulation levels, and windows, to B. C. Hydro recommended levels, as outlined in Data Sheet H 206 Recommended Levels of Insulation (Appendix E),

or as could be negotiated, having consideration for the availability of products and necessary skills in the area.

B. C. Hydro also stipulated that the house was not to be electrically heated.

On completion, the builder was to have an open-house to permit the public to see the finished product.

The district managers in the diesel areas were assigned the task of locating one house each and negotiating with the builder to participate.

The search was successful only in Bella Coola. The builder/owner (hereafter referred to as Mr. R) had purchased a modular "kit" house that consisted of a preserved wood foundation (PWF) with RSI 4.9 (R 28) polystyrene insulation. The walls were 38 x 89 mm (2 x 4) with plywood sheathing, shipped in pre-assembled sections. The windows are wood frame, double glazed, most with low emissivity (Low E) glass. Mr R. stated that he would be heating with wood.

In the negotiations between B. C. Hydro and Mr. R, it was agreed that the home would be accepted if wall insulation was brought up to at least RSI 4.9 (R 28) and the ceiling insulation to RSI 7 (R 40). Wood stoves and fireplaces with a source of combustion air directly into the firebox were also stipulated.

Mr. R chose a double stud wall technique to upgrade the walls and actually exceeded the requirements by installing RSI 5.3 (R 30).

Mr. R held an open house during the Bella Coola Fall Fair, on 6 September 1987. He left some of the drywall off so people could see the construction method and he was present all day to give visitors a complete explanation of what he did. Mr. R. has proven to be most cooperative and enthusiastic throughout. Payment of $2500 was approved as a result of the first open house. Under terms of the agreement, a second open house is required when the house is completed, at which time payment of the final $500 will be approved.

The failure to locate participating builders in the Queen Charlotte Islands and the Stewart/Atlin areas has been attributed to the economic turndown in these areas. Few new houses are being built, those that are, are often native housing and the Ministry of Indian Affairs and Northern Development has its own programs for these.

LARGE BUILDING RETROFIT DEMONSTRATION

One building stood out as an ideal candidate for the commercial building retrofit phase of this project: the Forestry Building in Hagensborg near Bella Coola.

This is a relatively new electrically heated office building leased for the B. C. Ministry of Lands and Forests by the British Columbia Buildings Corporation (BCBC), a crown corporation responsible for managing all B. C. Government buildings.

A comparison of all the accounts in the diesel districts showed it to have the seventh highest consumption of all accounts, and the highest consumption of all electric heating accounts. When approached to see if they would be interested in participating, BCBC responded immediately by hiring a consultant to do a survey of the building and recommend energy efficiency improvements.

The suggested improvements included the following:

- reduce lighting levels in corridors and open spaces both by removing some fixtures and relamping with 34W fluorescent lamps;
- reduce lighting in the warehouse;
- remove control of washroom exhaust fans from light switches and install spring-type timers;
- repair some defects in the building structure;
- install "casablanca" fans in the warehouse.

These measures were estimated to cost approximately $3,500 and result in a 15% saving in energy used.

This proposal complied with program requirements of being simple and easily duplicated by any building owner or tenant at low cost, with a fast return on investment.

BCBC also proposed the installation of heat pumps to further reduce energy consumption. B. C. Hydro was reluctant to accept this concept, as heat pumps were considered to be outside the program requirements (simple and low cost). There was also concern that savings on winter heating would be offset by summer cooling (the building did not have a cooling system and is known to overheat in summer), and that service and maintenance would be a problem.

BCBC pointed out that they were well qualified to look after the service and maintenance aspects, and it was agreed that heating savings would outweigh cooling use.

After consulting with EMR, B. C. Hydro approved the project as proposed by BCBC. BCBC spent an estimated $50,000; EMR contributed $5,000. B. C. Hydro made no cash contribution, but provided all necessary administration during the negotiations with BCBC and will do the monitoring of consumption.

MONITORING & RESULTS

Residential

The following procedures were employed in determining the impact of the blankets and shower heads on annual consumption of electricity.

1) All houses determined to be electrically heated were eliminated from consideration. Actual degree day data are not available for all the communities involved and it was presumed that the effect of weather would mask the expected relatively small effect of the conservation measures.

2) All houses that had a change in owners, tenants or occupancy during the study period, as indicated by a change in account number, were eliminated. It is well known that energy consumption in a home is a function of family size and lifestyle and can change significantly with a change in occupancy, masking any effect of the conservation measures.

3) It was observed that some accounts had extreme differences in consumption from one year to the next. After computing before and after conversion consumptions the before/after ratio was calculated and ranked, and the upper and lower deciles were eliminated.

4) From a base of approximately 4,000 residential accounts with approximately 2,500 blankets installed, the control group (neither blanket nor shower restrictor installed) was 409 accounts. Of customers who received a blanket only, 129 were in the data base, and of those who received both blanket and restrictor, 88 were in the data base one year after the program ended.

5) Consumptions (kW.h) for both control and study groups for the 12 months period before the program began, i.e. January 1, 1986 to December 31, 1986, were compared with consumptions for the 12 months period April 1, 1987 to March 31, 1988.

The results are summarized in the following table.

	Before Conversion				After Conversion				% Changed
	86/01/01 - 86/12/31				87/04/01 - 88/03/31				
	low	st.dev	high	mean	low	st.dev	high	mean	
Control Group	3996	2496	18461	9261 (409)	5659	2171	16942	10058 (409)	+8.6
With Device - Total Sample	5495	2290	17511	10952 (217)	6175	2070	15057	10802 (217)	-1.4
With Blanket Only	5495	2290	17511	10783 (129)	6175	2225	15057	10580 (129)	-1.8
With Blanket and restrictor	6225	1948	15108	11199 (88)	6373	1783	14986	11127 (88)	-.64

Commercial Building Retrofit

B. C. Hydro's billing records were used to monitor the performance of this building through one heating season before retrofit and one after.

Results are as follows:

From	To	Consumption kW.h	Peak Demand kW	Charges
8 Oct/86	9 Jun/87	308,600	236	$19,730
8 Oct/86	10 Jun/88	231,400	176	$13,864
Savings		77,200 (25%)	60	$5,866 (29.7%)
Savings - Litres of Oil		24,900		

The Celsius heating degree days for Bella Coola for the calendar months October - May 1986-87 and 1987-88 were 3047 and 3138 respectively. Thus the savings were obtained in spite of a 3% colder winter.

With the installation of heat pumps, mechanical cooling of this building became possible for the first time. Energy consumption and demand for June, July and August of 1987 and 1988 were as follows:

	Consumption kW.h		Demand kW		Charges	
	1987	1988	1987	1988	1987	1988
June	13,400	12,200	120	48	$ 922	$ 648
July	16,200	14,200	96	52	961	760
August	14,000	13,400	120	52	947	727
3 month total	43,600	39,800			2,830	2,135

Thus, even with the addition of air conditioning, both consumption and demand were reduced in the summer months. These reductions are presumed to be due to the use of programmable thermostats and more intelligent operation of all systems in the building.

DISCUSSION OF RESULTS

Residential

The net difference between the control group and the group that received an energy saving device is 10%, resulting from an average 797 kW.h increase by the control group and a decrease of 150 kW.h by the "study" group. The total difference is 947 kW.h/yr.

However, it should be noted that the control group had a 1986 average consumption 15.4% below the average for the study group. Some of their increase may be due to a lifestyle "catch up". Even after the program, the

control group has a lower average consumption than the study group. Some of the houses in the control group may have oil, propane or other non-electric water heaters, thus accounting for some of the lower usage.

The group that installed both blanket and restrictor saved less than those that installed the blanket only, indicating that the shower restrictors resulted in an increase in hot water usage. This is completely contrary to what would be expected from the use of a simple orifice device. While user dissatisfaction with a shower restrictor may lead to its removal, thus saving nothing, there is no apparent reason why there should be a resulting increase in hot water usage. Further testing/monitoring of shower restrictors is required to obtain definitive data on their effectiveness.

Commercial Building

The expenditure on the commercial building retrofit was approximately $50,000. With (uncorrected for weather) savings of $6,375/yr, simple payback is 7.8 years.

This exceeds the payback criteria for most commercial businesses (which look for 3 - 5 year paybacks), however, BCBC considers the expenditure acceptable because they now have summer cooling and a more comfortable building year round.

RESULTS OF OTHER PROGRAMS AND STUDIES

In a laboratory test conducted by the Ontario Research Foundation[1], the annual standby energy loss from a conventional electric water heater was 815 kW.h/yr. with an average water to air temperature differential of 40°C (72°F). The loss with a nominal RSI 1.76 (R-10) blanket was between 597 kW.h/yr (tightly wrapped) and 585 kW.h/yr (loosely wrapped). Thus, the savings due to the RSI 1.76 (R-10) blanket were from 218 to 230 kW.h/yr.

In tests performed by the U.S. Dept. of Energy, Bonneville Power Administration (BPA), wrapping a conventional 197L (43 I gal) electric water heater with an RSI 1.9 (R 11) blanket showed savings of 565 kW.h/yr[2] and 573 kW.h/yr.[3]

In the Hood River Project[4] average savings of 714 kW.h/yr were attributed to tank blankets and 232 kW.h/yr to low flow shower heads. The effect of tank thermostat turndown was not segregated, but is apportioned between blankets and shower heads. From a 1987 study by B. C. Hydro for the Canadian Electric Association[5] it is estimated that a saving of 300 kW.h/yr would result from thermostat turndown from 60°C (140°F) to 49°C (120°F).

SUMMARY

The success of a utility directed community level conservation program depends on the following:

- a commitment by management at the district (community) level that the program succeed;
- aggressive promotion, at the personal level if necessary;
- contractors with personal initiative.

REFERENCES

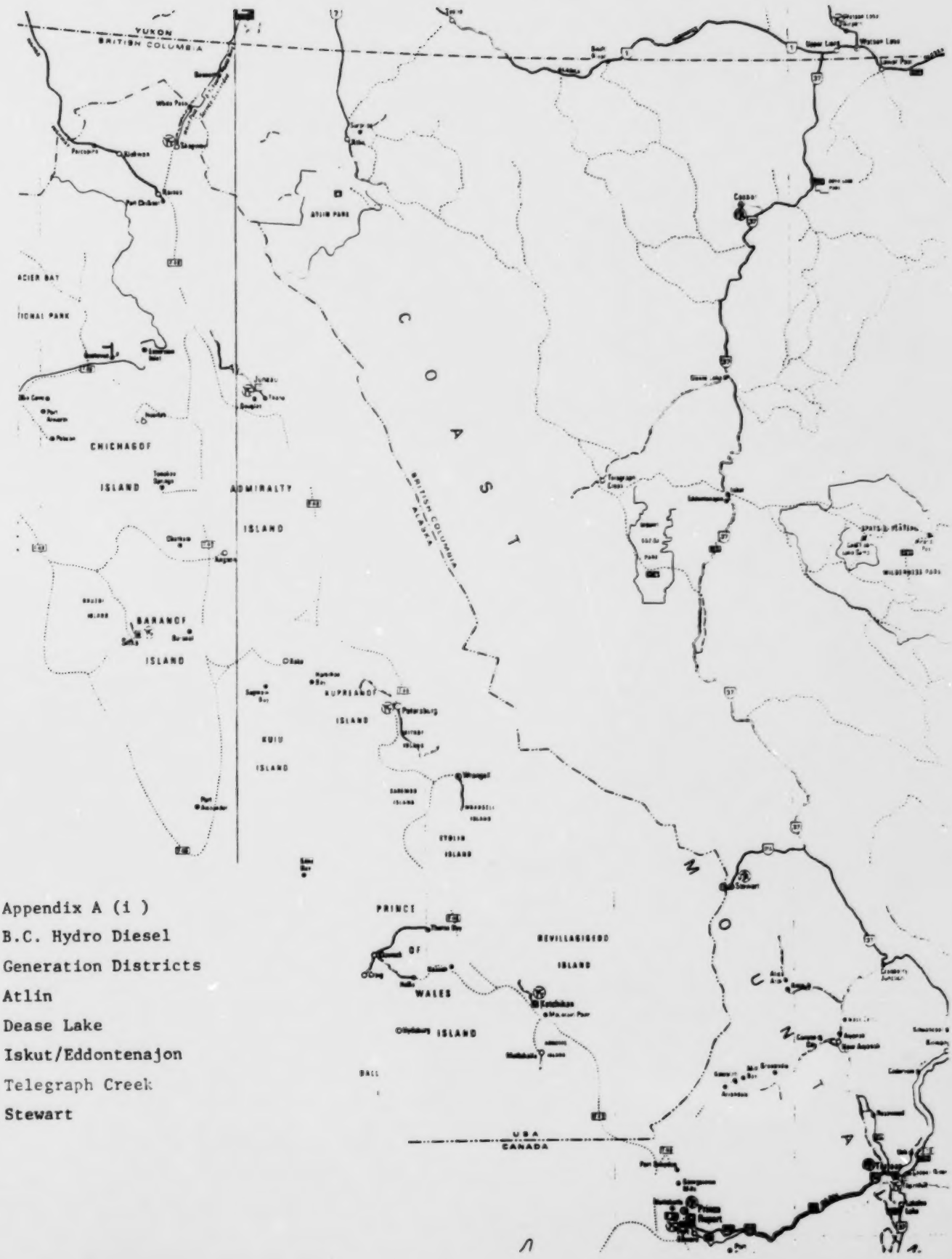
1. Report of Investigation ES/ESC - 38208-83
"Reduction and Unsafe Applications of Add-On Insulation Blankets for Electric Water Heaters". Ontario Research Foundation, December 1983.

2. C. D. Auburg, C. W. Ek, and P. W. Thor, "Electric Water Heater Energy Retrofits - Safety and Energy Savings", Bonneville Power Administration, Portland Oregon. Presented at the ASHRAE 1983 Winter Meeting, Atlantic City, New Jersey. ASHRAE Transactions, Volume 89, Part 1B.

3. J. R. Beimer, C. D. Auburg and C. W. Ek, "Domestic Water Heating - Summary Research Findings for Conventional Systems" Bonneville Power Admin. Portland Oregon. Presented at the "Conservation In Buildings: Northwest Perspective" conference, Butte, Montana, May 1985.

4. M. A. Brown, D. L. White and S. L. Puracker "Impact of the Hood River Conservation Project on Electricity Use for Residential Water Heating", Oak Ridge National Laboratory, Tennessee.

5. CEA Research Contract 438USOA "Residential Domestic Water Heating Advisory Computer Program", B. C. Hydro and Power Authority Residential and Commercial Energy Management, Vancouver, B. C.



Appendix A (i)

B.C. Hydro Diesel

Generation Districts

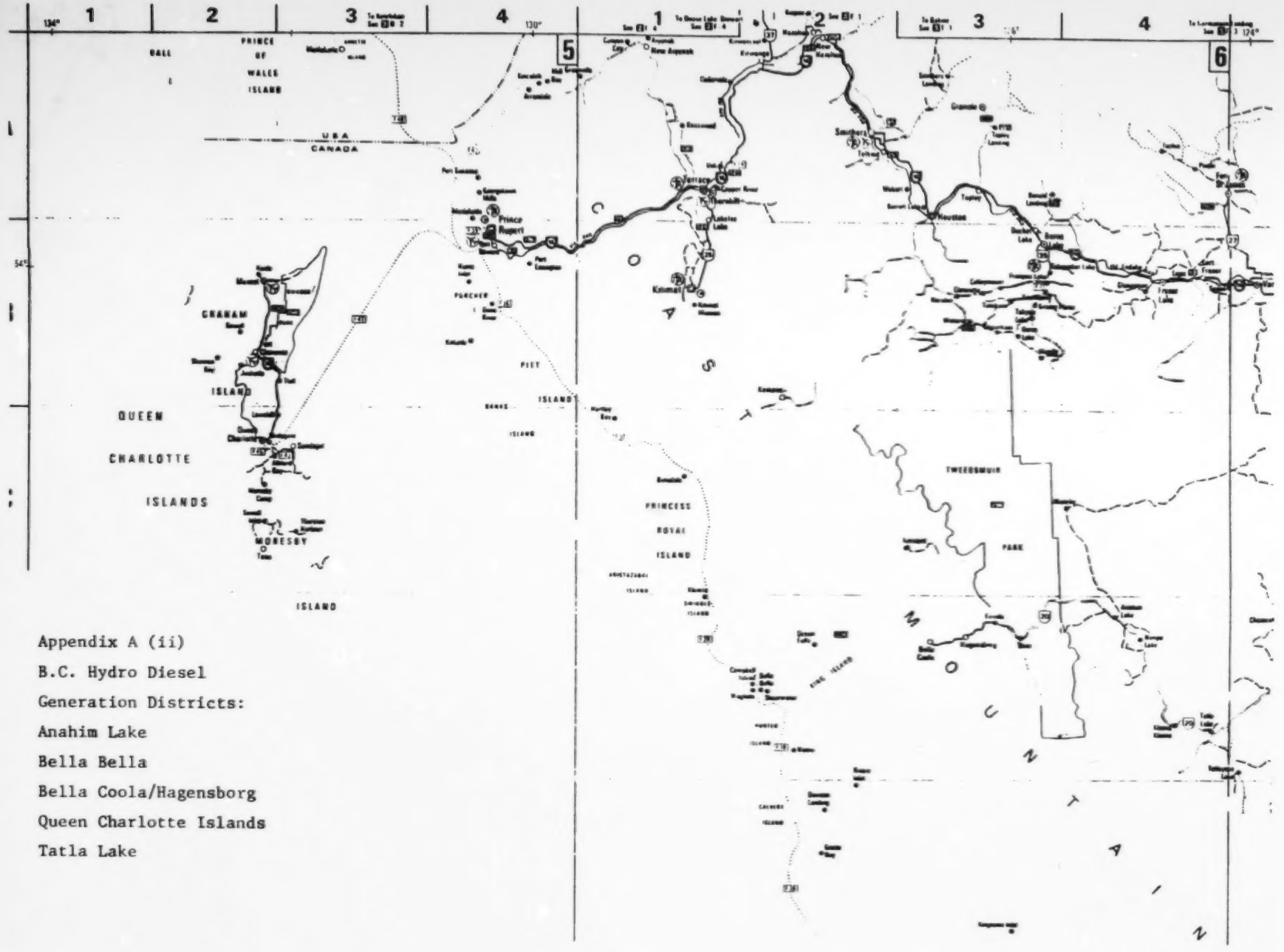
Atlin

Dease Lake

Iskut/Eddontenajon

Telegraph Creek

Stewart



Appendix A (ii)

B.C. Hydro Diesel

Generation Districts:

Anahim Lake

Bella Bella

Bella Coola/Hagensborg

Queen Charlotte Islands

Tatla Lake

Diesel Area Conservation Program

B.C. Hydro and Energy Mines & Resources Canada are sponsoring an electric water heating conservation program in diesel power generation areas.

To register your home for free installation of a water tank insulation jacket, shower flow regulator and tank thermostat adjustment*, please fill in this card and return it to your local B.C.Hydro office.

See Other Side

* All subject to the tank being in good condition, with appropriate wiring, and the shower arm being in good condition. Tank settings will not be changed without your approval.

B.C.Hydro

Diesel Area Conservation Program

Yes, I am interested in having B.C.Hydro:

- ☐ Install an insulating jacket on my electric water heater.
- ☐ Install a flow reducer in my shower
- ☐ Check and re-set the thermostat in my water heater.

(please print)

Name: _____

Address: _____

Town: _____

B.C.Hydro Account Number: _____

Telephone Number: _____

Appendix C

DIESEL AREA CONSERVATION PROGRAM
CONTRACTOR TRAINING WORKSHOP

AGENDA

DAY 1

8:00	-	9:00	Group Breakfast
9:00	-	9:15	Introductions
9:15	-	9:45	Background and Objectives (diesel generation costs; the Anahim Lake pilot project; monitoring; other aspects)
9:45	-	10:00	Coffee
10:00	-	11:00	Administrative Procedures (record forms, invoicing)
11:00	-	12:00	Helpful advice from the electrical inspector - resetting thermostats - checking for electrical hazards - wire sizes, limitations, identification
12:00	-	1:00	Lunch
1:00	-	1:30	EMR - A word from our co-sponsor Objectives; other RCDP projects
1:30	-	2:30	Installing the jacket
2:30	-	2:45	Coffee
2:45	-	3:15	Installing shower restrictors
3:15	-	4:15	Open forum

Appendix C

DAY 2

HOME HEATING

8:30	- 9:00	Where does the heat go?
9:00	- 10:00	Where's the R in insulation? OR Why does insulation retard heat flow?
10:00	- 10:15	Coffee
10:15	- 11:00	Air-vapor barriers, air sealing - experiences and problems
11:00	- 12:00	B. C. Hydro insulation recommendations
12:00	- 1:00	Lunch
1:00	- 2:00	The handout package
2:00	- 4:00	Open forum on home insulation and energy conservation

APPENDIX D

B.C.Hydro
Diesel Area Conservation Program

INSTALLATION RECORD

Customer's Name: _____

Address: _____

Account Number: _____ Date: _____

Start Time: _____ Finish Time: _____

- House Size (including basement):

  less than 1,000 sq.ft. ☐
  1,000 - 1,200 sq.ft. ☐
  1,200 - 1,400 sq.ft. ☐
  1,400 - 1,800 sq.ft. ☐
  over 1,800 sq.ft. ☐

- Does this home have permanently wired electric heating?

  Yes ☐ No ☐

- How many people live in this house? _____

	COMPLETED Yes	No
1. Electric Hot Water Tank Wiring Checked	☐	☐
2. Electric Hot Water Tank Continuity Test	☐	☐
3. Electric Hot Water Tank Temperature Adjustment	☐	☐
4. Electric Hot Water Tank Insulation Jacket Installed	☐	☐
5. Shower Restrictor Installed	☐	☐

6. Customer's Comments on Project

_____

_____

_____

Completed by: _____
signature

B.C.Hydro

RECOMMENDED INSULATION LEVELS

Insulation is one of the most effective ways by which a building owner can conserve energy and reduce heating equipment installation costs, without sacrificing comfort.

B.C. Hydro recommends the insulation levels shown in this data sheet for economy of operation and energy conservation.

LEVELS OF INSULATION

Recommended Levels

The recommendations involve some minor compromises between the desirable optimum, the limitations of current construction practice and the requirements of the Canadian Electrical Association's Energy Efficient ℓ² Home Program. Where innovative construction techniques permit, it is desirable to exceed the recommended insulation levels for your area.

To determine the recommended insulation levels for your area:

a) determine degree days for your area from Table 1. (If your city is not listed, choose the centre closest to you.)

b) obtain applicable insulation category from Table 2, using the appropriate degree day range and fuel type.

c) refer to that category in Table 3 which will indicate the recommended levels of insulation.

Optimum Levels

Where the insulation is at optimum level, the savings in energy cost over the life of the applicaton will equal or exceed the initial cost of installing it, plus interest on this investment.

Several factors affect the optimum level:

- weather pattern (usually expressed in degree days)
- cost of energy
- installed cost of insulation
- life expectancy of the application
- cost of money (interest rate)
- fuel cost escalation rate

Minimum Levels

Insulation levels outlined in various building codes and standards are generally minimal good practice because they are intended for mandatory regulation.

These standards, such as the "Measures for Energy Conservation in New Buildings — 1978" or American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) Standard 90A-1980, often make no differentiation with regard to fuel cost. In British Columbia, the cost of heating identical homes in the same location can vary by a factor of more than two, depending on the fuel used. Consequently, the optimum and the recommendations vary accordingly.

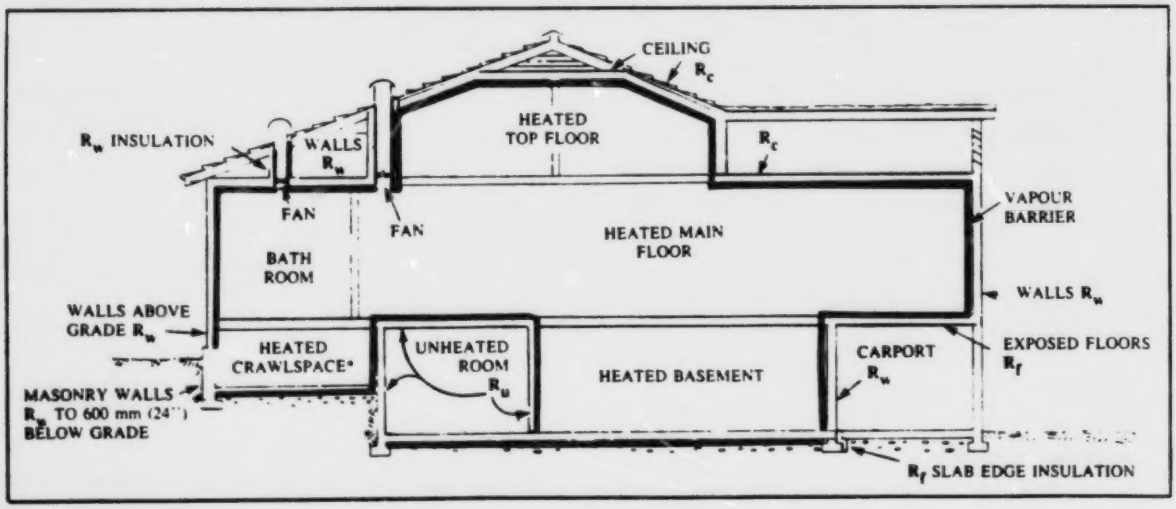
Table 1 Celsius Degree Days for Various B.C. Communities

Location	Degree Days	Location	Degree Days	Location	Degree Days	Location	Degree Days
Bella Coola	3847	Golden	4931	New Hazelton	4996	South Slocan	3877
Blue River	5114	Gulf Islands	3045	100 Mile House	5154	Sparwood	4914
Burns Lake	5773	Hope	3148	Pemberton	4041	Squamish	3379
Cache Creek	3800	Kamloops	3639	Port Hardy	3674	Stewart	4690
Campbell River	3365	Kelowna	3612	Powell River	2862	Terrace	4296
Cassiar	7594	Langley	3117	Prince George	5376	Trail	3573
Chilliwack	2931	Lytton	3361	Prince Rupert	3863	Valemount	5252
Clearwater	4320	MacKenzie	5897	Quesnel	4795	Vancouver	3031
Cranbrook	4807	Massett	3791	Revelstoke	4146	Vanderhoof	5687
Creston	3849	Merritt	4218	Rossland	4435	Vernon	3887
Dawson Creek	6234	Nanaimo	2999	Salmon Arm	3930	Victoria	2947
Fort Nelson	7087	Nelson	3734	Smith River	7616	Williams Lake	5179

Table 2 Category for Insulation Levels

Degree Days / Fuel	Up to 3500	Up to 5000	Up to 6500	Up to 8000
Gas	1[1]	1	2	3
Electric[2]	2	3	3	4
Oil	3	4	4	4

1 Except Victoria — use Category 2.
2 In diesel generation areas, use Category 4.



**If unheated crawlspace, insulate the floor above to R_u*

Figure 1 Recommended Location of Home Insulation

Note: Symbols (R_w, R_c, etc.) are for cross reference to Table 3.

Table 3 Recommended Levels of Insulation
For Residential and Small Commercial Building Construction[1]

ELEMENT	THERMAL RESISTANCE, RSI[(2)]m^2 C/W			
	Category 1	Category 2	Category 3	Category 4
WALLS (R_W)				
Frame (new)	3.5 (20)	3.5 (20)	4.4 (25)	5.3 (30)[3]
Frame (existing)	If existing wall is uninsulated, fill entire stud space When renovating, try to achieve "new" levels			
Solid wood (up to 100 mm (4") thick)	3.5 (20)	3.5 (20)	3.5 (20)	4.2 (24)
Solid wood (125 mm (5") and thicker)	2.1 (12)	2.1 (12)	2.1 (12)	3.5 (20)
Masonry (over 300 mm (12") above grade)	3.5 (20)	3.5 (20)	3.5 (20)	4.9 (28)
Masonry (below grade up to 300 mm (12") above grade)	2.1 (12)	2.1 (12)	2.1 (12)	2.6 (15)
CEILINGS & ROOFS (R_C)				
Ceilings, vented above[4]	7.0 (40)	7.0 (40)	9.2 (52)	10.6 (60)
Solid roof deck (new)	7.0 (40)	7.0 (40)	7.0 (40)	7.0 (40)
Ceilings, between floor with radiant ceiling heating	1.2 (7)	1.2 (7)	1.2 (7)	1.2 (7)
Solid roof deck (existing)	Not economical to retrofit unless remodelling			
FLOORS (R_f)				
Over areas exposed to outdoor temperatures	5.6 (32)	5.6 (32) (or maximum of full joist space)	7.0 (40)	7.0 (40)
Slab on grade (edge insulation)				
Heated slab	2.6 (15)	2.6 (15)	2.6 (15)	3.5 (20)
Unheated slab	2.1 (12)	2.1 (12)	2.1 (12)	2.6 (15)
AROUND & OVER UNHEATED ENCLOSED AREAS (R_U)	3.5 (20)	3.5 (20) (Max. stud or joist space but not less than R20)	3.5 (20)	3.5 (20)
WINDOWS & SLIDING GLASS DOORS[5]	Triple[6] Glazed	Triple[6] Glazed	Triple[6] Glazed	Quadruple[7] Glazed
DOORS	0.7 (4) or stormed	0.7 (4) or stormed	0.7 (4) + storm	0.7 (4) + storm

1 For large commercial and institutional buildings use life-cycle cost allowing for the tax and situation applicable. Future data sheets in the H 200 series will provide suggested methods.

2 Imperial units, usually referred to as "R" values are given in brackets. The resistance values listed are for insulation only.

3 This is the practical maximum level of insulation with single wall construction. Higher levels can often be justified (see data sheet H 205) and can be achieved with innovative double wall technology.

4 Same levels apply with radiant ceiling elements.

5 All windows should have 12 mm (½") airspace between glass layers. All metal sash multiple glazed units should have a thermal break unless a storm sash is used.

6 Triple glazed windows can be double glazed plus storm sash.

7 Quadruple glazed windows can be two double glazed units or a triple plus storm sash.

RECOMMENDATIONS

New Buildings

- For best results, the recommended insulation levels in Table 2 should be installed subject to the limitations listed and to the requirements of national and/or local building codes.
- Roof and ceiling insulation should be carried to the outside of the exterior wall. However, the level may be reduced near the eaves to accommodate the roof slope and ventilation clearance. The minimum insulation value above the exterior wall should be at least RSI 3.5 (R20).
- Insulation applied to the exterior of a masonry wall below grade or to the edges of a floor slab on grade should extend at least 600 mm (24") below the adjacent exterior ground level.
- Total window area should not exceed 15% of the floor area and should, where possible, be concentrated on the south-facing wall.

Existing Buildings

- For best results, the floor and ceiling insulation should be increased to at least the recommended levels.
- Walls with existing insulation should be left alone unless renovations make the addition of more insulation practical.
- Walls with no insulation should be insulated by blowing insulation to fill the stud space completely.
- Additional glazing should be added to existing windows, and excessive window area reduced where practical.

REFERENCES

B.C. Hydro Data Sheet H 205 — "A Method for Calculating Optimum Levels of Insulation"
H 210 — "Typical Residential Insulation Practice and Recommendations"
H 213 — "Energy Conservation in Mobile Homes"
Canadian Electrical Association — "Double E Home Program — Technical Guidelines for New Homes"
— "Double E Home Program — Technical Guidelines for Existing Homes"

INSTALLATIONS

The information provided herein is a guide only. B.C. Hydro is not responsible for installations. These should meet the current requirements of the owner, manufacturer's instructions and all applicable codes, standards and regulations.

ADVISORY INFORMATION

Helpful advisory information for the trades and Hydro customers is available from the Advisory Services Section of your local B.C. Hydro office or the Energy Use Engineering Department, 625 Howe Street, Vancouver, B.C. V6C 2T6. In the Lower Mainland call 298-2411 and ask for Advisory Services.

1983 JULY: ZER/GHP
energy use engineering department
70391 84-04

energy management division
B.C. Hydro